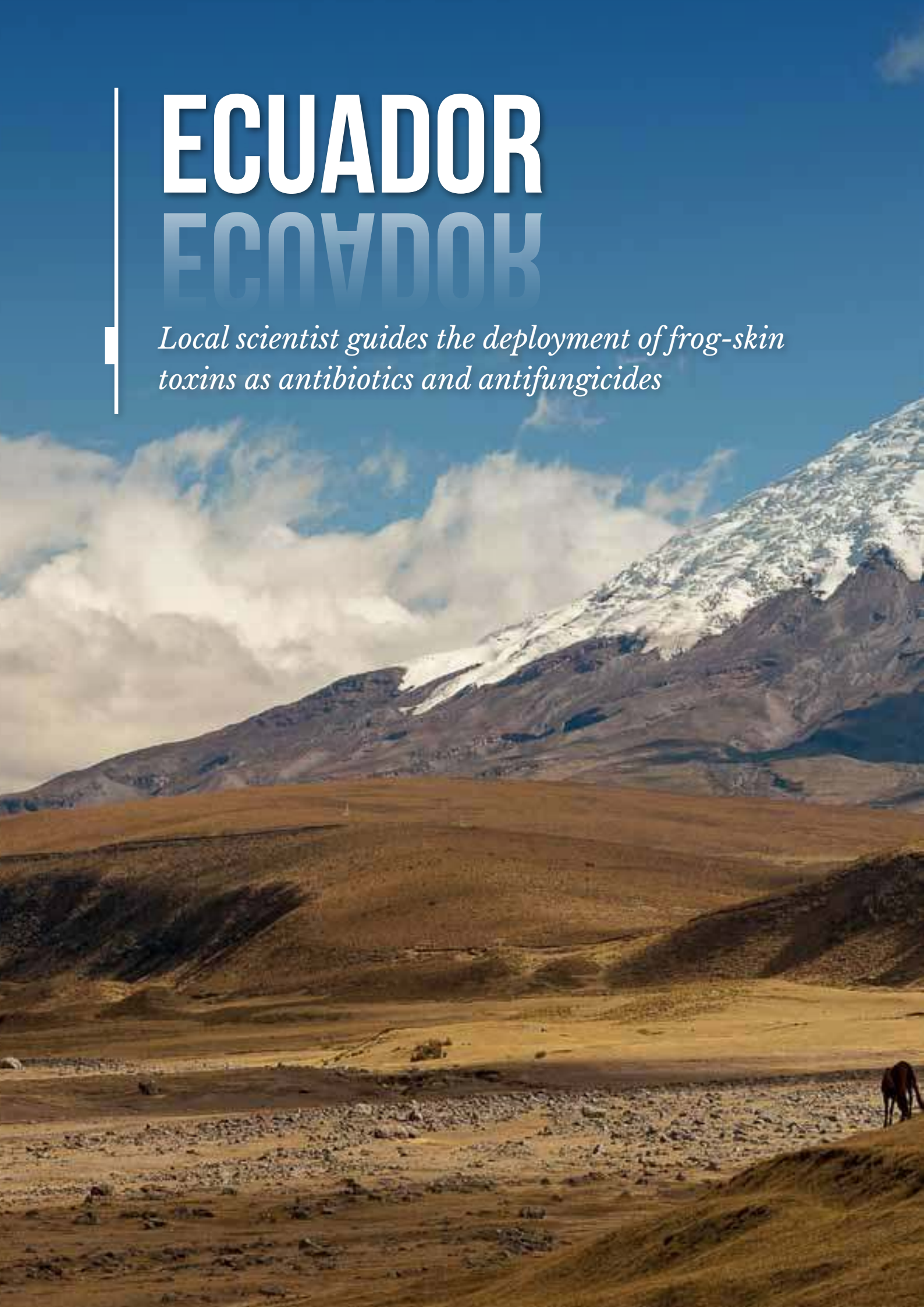
ECUADOR

Local scientist guides the deployment of frog-skin toxins as antibiotics and antifungicides



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SETTING THE SCENE

Ecuador is a megabiodiverse country that conserves and uses in a sustainable way the resources coming from traditional knowledge of *Pachamama* (Mother Earth). The name of Ecuador refers, precisely, to the geographical location of this country on the equator. Ecuador is classified as one of the 17 countries with the greatest biological diversity on the planet. This geographical position, the presence of the Andean Mountains and the confluence of important ocean currents, explain the existence of 91 types of terrestrial and 24 types of marine ecosystems, in a small territory of 283 560 km^2, which shelters, for example, 4 300 species of orchids, of which 40% exist only in Ecuador; 1 642 species of birds and 18 198 species of vascular plants, representing 5.7% of all plants on the planet.

In relation to the size of the planet, Ecuador represents only 0.1% of the total land surface, but when analyses per square kilometre are performed, Ecuador leads in biological diversity per unit area. A particularly extraordinary case is the variety of amphibians in Ecuador. While Brazil and Colombia have the largest number of amphibians in their territories, followed by Ecuador, when the analysis per square kilometre is performed, Ecuador exceeds Brazil by 21 times and Colombia by almost 3 times; Ecuador has about 600 species of amphibians, especially in the foothills of the Andes.

This small country is also a multi-cultural and multi-ethnic state, with 13 indigenous nationalities, located on the coast, mountain range and Ecuadorian Amazon, along with significant populations of Afro-Ecuadorians and "montubios". This combination of biological diversity and huge cultural richness means great opportunities, as well as challenges, for the sustainable use of genetic resources, derived from flora and fauna, associated or not, with traditional knowledge. An experience that demonstrates the biomedical and economic potential of the use of biodiversity was developed by Universidad Regional Amazónica IKIAM, in Muyuna Campus, in the Ecuador Amazon.

Biodiscovery case

A new family of peptides (molecules formed by the union of several amino acids), which have antimicrobial properties, was discovered in the skin of the "splendid leaf frog" (*Cruziohyla calcarifer*, Hylidae). This new group of molecules was named *cruzioseptinas* and have been shown to have properties for protection against bacteria and yeast. The frog lives in the jungles of Chocó, in the Northwest of Ecuador, and is one of the focal species of the GEF Project for the "Conservation of the Biodiversity of Ecuadorian Amphibians and Sustainable Use of their Genetic Resources" – PARG, an ABS/Biodiversity initiative allied to the GEF Global ABS Project, executed, both projects, by the Ministry of Environment of Ecuador (MAE, by its Spanish acronym), with the support of the UNDP.

The study is being led by Carolina Proaño Bolaños, a young Ecuadorian scientist who worked at Queen's University, Belfast, in Northern Ireland, United Kingdom. Currently a Research Professor at Universidad Regional Amazónica IKIAM, strategic partner of PARG and ABS Projects, in the field of research and characterization of unknown bioactive molecules, derived from the skins of these animals. The scientific data collected show the great molecular diversity contained in the skin of this species, in which 53 new peptides have been identified to date. One of these molecules has the potential for the development of a new class of antibiotic and antifungicide, for medicinal use.

To get an idea of the importance of this discovery, since 2015, around 1 600 antimicrobial molecules have been registered from 165 species and 25 genera of amphibians in the world. Of these, 165 peptides of the *dermaseptin* family have been isolated in frog species of Central and South America.

Other species in the same family have been investigated by Dr Proaño, also in the framework of the referred PARG project, *Agalychnis spurelli* (the gliding tree frog) and *Boana picturata* (the colorful arboreal frog). Dr Proaño and her team of researchers discovered 13 and 7 new peptides, respectively, also with very high biological activity.

In Ecuador, more than 80 framework contracts for access to genetic resources have been signed thus far, for research and use of the genetic information of plants and animals; however, the greatest potential is demonstrated by the amphibian group, where 250 species are endemic to Ecuador, that is, 42% of the 600 species existing in the country.

EYEWITNESS STATEMENT

"There are two main reasons for studying frog skin secretions. First, I learnt about epibatidine – a pain killer alkaloid produced by the Ecuadorian poison frog, Epipedobates anthonyi, Dendrobatidae, that is 200 times more potent than morphine without addictive effects. Characterization of this alkaloid was performed in USA without participation of any Ecuadorian scientists. Second, Ecuador has an extraordinary biodiversity including ~581 species with ~40% endemism. However, at least 28% of these species are under extinction risk. Which makes the study of skin secretions a priority because with every extinct species also disappears the chemicals hidden in their skin. For those reasons, I decided to become a scientist exploring the secrets of Ecuadorian frog skin.

My aim is to unravel the complexity of chemical compounds in frog skin secretions of Ecuadorian amphibians. In particular, I am interested in antimicrobial and pharmacological active peptides. Through scientific research, I would like to understand the biological function of these molecules in the organism evolution context but also to identify lead molecules for the development of new drugs. I think that we have a responsibility to develop a science base for exploiting our biodiversity in a sustainable way for wealth creation from our unique natural resources not only for local benefit but also for the world.

Back in 2002, my research in Ecuador was pioneering but now there are strong lines of research developing studies on frog skin secretions in two local universities. As a result, I have already started to unravel the skin secretion peptides from three Ecuadorian species discovering at least 73 peptides including three novel peptide families with antimicrobial activity but more importantly, I am working with my colleagues at PUCE to transfer to them the technology and knowledge I have developed during my PhD training."

DR CAROLINA PROAÑO BOLAÑOS, Research Professor at Universidad Regional Amazónica IKIAM

In fine focus: SDGs implemented by the biodiscovery case

An innovative exercise was carried out, sponsored by the German Cooperation in Ecuador and the Ministry of the Environment, about the economic potential of the genetic resources derived from Ecuadorian amphibians. This exercise, which took the research of Universidad Regional Amazónica IKIAM as a reference, concluded positively about the significant economic benefits that genetic resources could represent for Ecuador, in the event that the investigations prove successful, after several years of successfully dealing with each one of the different stages usual in this type of investigations.

In essence, genetic resources have huge economic potential, in addition to medical, nutritional or cosmetic potential, that could contribute to the development of indigenous peoples or local communities, owners of traditional knowledge, linked to biodiversity. Likewise, genetic resources would contribute to a new model of national development and constitute an investment opportunity for the private sector. Thus, the greater the benefit perceived by the population, derived from biodiversity, the greater will be the awareness of its value and the greater resources and efforts available for conservation and sustainable development. In conclusion, there is an obvious contribution to the SDGs aimed at health and well-being (SDG 3), the development of industry, innovation and infrastructure (SDG 9), reaching sustainable cities and communities (SDG 11) and the life of terrestrial ecosystems (SDG 15).

Legal and political enabling environment for ABS and the Nagoya Protocol

Since 1996, ABS issues in Ecuador have been regulated by Decision 391 on the Common Regime on Access to Genetic Resources of the Andean Community of Countries. In 2011, the Ecuadorian government issued Executive Decree No. 905 on access to genetic resources to regulate key aspects of Decision 391 at a national level. This national framework was strengthened in 2016 and 2017 with the Organic Environmental Law, the intellectual property law "Ingenios (Ingenuity)" and the ratification of the Nagoya Protocol. Currently, the challenge is achieving adequate interinstitutional coordination between MAE (Ministry of Environment), SENESCYT (Superior Secretariat of Science, Technology and Innovation), INABIO (National Institute of Biodiversity), SENADI (National Secretariat of Intellectual Rights) and others, with competencies established in these instruments, to ensure the development of a coherent and expeditious secondary regulation, applicable at the national level.

Indeed, the National Assembly approved the ratification of the Nagoya Protocol, which became fully effective as of December 2017. For this ratification, the Global ABS Project contributed to a workshop addressed to 75 assembly members, with the purpose of providing information that allows them to take an informed position on the matter, through presentations by experts that included Alejandro Lago, Rodrigo de la Cruz and the Minister of the Environment, Tarcisio Granizo, in July 2017.

These legal instruments constitute a valuable opportunity and, at the same time, a great challenge, since they changed the institutional competencies that were maintained until April 2017, centralized in MAE, by establishing SENESCYT as the governing entity of the national system of science and technology, including the power to extend research permits and sign framework contracts for access to genetic resources.

In order to favour interinstitutional dialog, a process is carried out that seeks transparency and consensus, through the Global ABS Project as a facilitator. Thus, after talks during the second half of 2017, the Project Steering Committee approved, on 15 January 2018, an interinstitutional roadmap for the ABS Regime in Ecuador that is being executed to date.

MESSAGE FROM AN SDG ADVOCATE

"The objectives of Sustainable Development are considered for us, the indigenous and local populations, as a symbol of a global pact, a way forward for governments, in order to contribute to improving the quality of life of the most vulnerable populations and the protection and conservation of the Pachamama (Biodiversity).

Therefore, it is important that all citizens know about the importance and impact of the 17 objectives for the development of countries. I am Ana María Guacho from Puruwá, a small community of Chimborazo Province, defender of the traditional knowledge rights of the indigenous and local peoples, because we, who are heirs of the ancestral wisdom, support the care of the moorland, the jungle, the mangroves and we know the value and meaning of the medicinal plants, in benefit of the physical and spiritual health of the members of our communities.

Achieving the fulfillment of sustainable development goals is a task for everyone, but the State has more responsibility through the Ministries, Municipalities and Parish Councils, to democratize their actions and link the direct participation of the population in the design of public policies, prioritizing the needs of each territory with a comprehensive vision, where the objectives of sustainable development are a fundamental part of their development plans. This is still a very difficult task, however, and to achieve influence from the territorial level we must legitimize our participation from a citizen initiative as I do, being representative of peoples and nationalities in the Cantonal Council for the Protection of Rights in the Municipality of Riobamba. From that space I have been able to strengthen the rights of women, of the Puruwá indigenous people and the conservation of biodiversity, which are priorities in the 2030 Agenda of the United Nations."

ANA MARÍA GUACHO, Puruwá, Chimborazo